Lecture 5

Thurs: Discussion / quiz

111 Ex 23, 25, 26, 27, 29, 32, 33, 37] location to solutions in general.

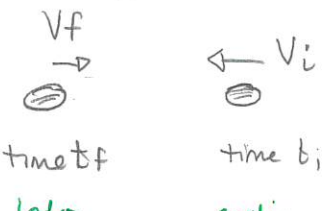
Fri: Read as per website.

This class
* use definition of acceleration to calculate acceleration + meaning.
* use acceleration to calculate velocities if acceleration is constant.
* acceleration and graphs of v vs t.
* sign of acceleration.

Average acceleration

Acceleration describes the rate at which velocity changes. The preliminary definition is

> The average acceleration of an object over an interval is
>
> $$a_{avg} = \frac{\Delta v}{\Delta t} = \frac{v_f - v_i}{t_f - t_i}$$
>
> where v_i = velocity at time t_i
> v_f = " " " t_f



We saw in the previous exercise that the acceleration describes the change in velocity each second.

Quiz 1 100%

Quiz 2 90%

DEMO: Moving Man PhET
* Initial
$x_0 = 0$
$v_0 = -6$
$a = 2$

} Observe three phases
1) start to just before the turn at left
2) just before the turn at left to just after
3) just after the turn at left to end.

This illustrates some general facts:

1) acceleration can result from a change in speed ⇒ velocity changes
2) acceleration can result " " " in direction
3) acceleration can be positive when velocity is positive ⇒ velocity (includes direction) changes
4) acceleration can be positive when velocity is negative
5) acceleration is not connected to velocity at any single instant
   → moving man has many different velocities, always same acceleration.

Quiz 3 80%

6) Acceleration does not correlate directly with speed. One can have a faster speed but a slower acceleration.

Acceleration describes how velocity changes with time.

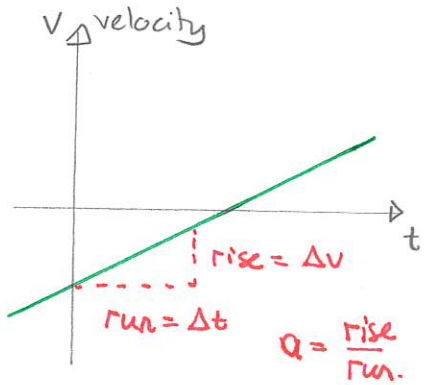
Constant acceleration

If acceleration is constant, then velocity changes at a constant rate.

If velocity changes at a constant rate then

a) a graph of v vs. t is a straight line

b) slope of a graph of v vs. t = acceleration



In this case, algebra gives

$$V_f = V_i + a\,\Delta t$$ Constant acceleration only

Derivation: $a = \frac{\Delta v}{\Delta t}$

$\Delta v = a\Delta t$

$V_f - V_i = a\Delta t$

$V_f = V_i + a\Delta t$

Warm Up 1

Sign of acceleration

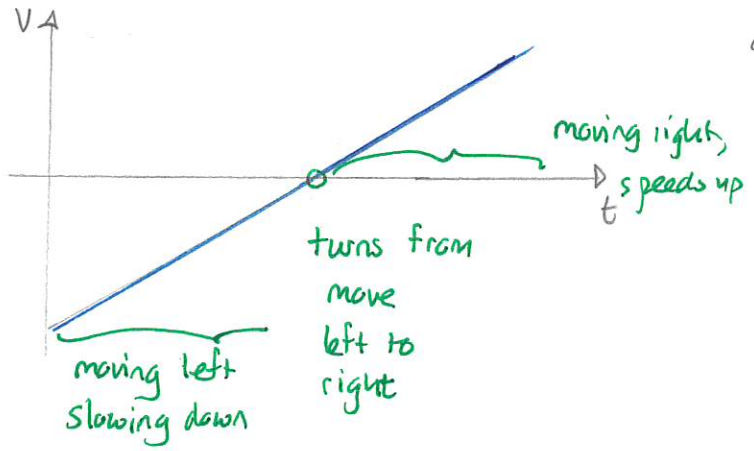
Acceleration can be positive, negative or zero. Interpreting the sign of acceleration is more complicated than the sign of velocity.

Quiz 4 30% - 90%

Quiz 5 80%

Thus:

Acceleration is positive if the object



a) moves right, speeds up

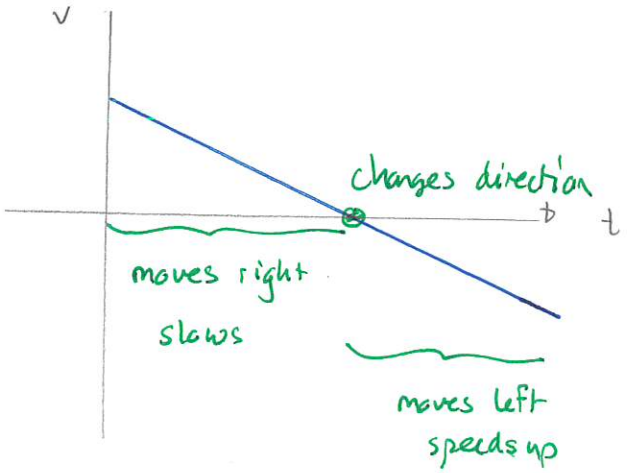
b) moves left, slows down

c) switches direction from left to right

Warm Up 2

On the other hand

Acceleration is negative if the object



a) moves right, slows down

b) moves left, speeds up

c) switches direction from right to left

Another way to see this is

Positive acceleration ⇒ velocity (number) increases

e.g.

earlier	later	
7.0 m/s	12 m/s	speeds up
	increasing number.	
−8.0 m/s	−3.0 m/s	slows down

Negative acceleration ⇒ velocity (number) decreases

e.g.

earlier	later	
7.0 m/s	3.0 m/s	slows down
	decrease	
−8.0 m/s	−12.0 m/s	speeds up.

Quiz 7

The signs of the acceleration will acquire a more intuitive meaning once we connect acceleration to force.

Note: the magnitude of the acceleration is the absolute value of the acceleration and ignores any sign.